CLAIMS

I claim:

1. A module in an audio communications system, comprising:
a first input for receiving a first audio signal;
a second input for receiving a second audio signal, wherein at least a portion of the second audio signal is an echo of the first audio signal;
a distortion module receiving the first audio signal, the distortion module adapted to model a distortion on the first audio signal and produce a distorted signal; and
an adder module for receiving the distorted signal and the second audio signal and adapted to use the distorted signal to remove at least part of the echo from the second audio signal.

2. The module of claim 1, wherein the first and second audio signals bear sequencing information and wherein the adder module is adapted to use the sequencing information to remove at least part of the echo from the second audio signal.

3. The module of claim 1, further comprising:
an audio generation module receiving the first audio signal and adapted to use the distortion module to model a distortion that occurs responsive to playing the first audio signal through a loudspeaker.

4. The module of claim 3, wherein the audio generation module comprises:
a modeling path having one or more distortion modules that model distortions on the first audio signal.

5. The module of claim 4, wherein each distortion module models a different type of distortion.

6. The module of claim 4, wherein the audio generation module alters the modeling path in real-time responsive to distortions that may occur on the first audio signal.

7. The module of claim 3, wherein the distortion module models an effect of amplifier clipping on the first audio signal.

8. The module of claim 3, wherein the distortion module models an effect of voice coil displacement on sound pressure waves produced by the loudspeaker responsive to the first audio signal.

9. The module of claim 3, wherein the distortion module models an effect of hysterisis in an iron core inductor on the first audio signal.

10. The module of claim 3, wherein the distortion module models an effect of harmonic distortion on sound pressure waves produced by the loudspeaker responsive to the first audio signal.

11. The module of claim 1, further comprising:

an acoustic echo estimation module receiving the first audio signal and for adapting the first audio signal to compensate for substantially linear changes in the second audio signal.

12. The module of claim 1, further comprising:

an audio sensing module receiving the first audio signal and adapted to use the distortion module to model a distortion that occurs responsive to sensing the second audio signal.

13. The module of claim 12, wherein the audio sensing module comprises:

a modeling path having one or more distortion modules that model distortions on the second audio signal.

14. The module of claim 13, wherein each distortion module models a different type of distortion.

15. The module of claim 13, wherein the audio sensing module alters the modeling path in real-time responsive to distortions that may occur on the second audio signal.

16. The module of claim 12, wherein the distortion module models an effect of microphone centerclipping on the second audio signal.

17. The module of claim 12, wherein the distortion module models an effect of amplifier zero crossing distortion on the second audio signal.

18. The module of claim 1, wherein the distortion module models a pre-established distortion.

19. The module of claim 1, wherein the distortion module is adaptive.

20. The module of claim 1, wherein the distortion module models a nonlinear distortion.

21. The module of claim 1, wherein the distortion module operates in a frequency domain.

22. A method of canceling an echo in an audio signal, comprising the steps of:
receiving a first audio signal;
receiving a second audio signal, wherein at least a portion of the second audio signal is a distorted echo of the first audio signal;
modeling one or more types of distortions on the first audio signal to produce a distorted audio signal; and

subtracting the distorted audio signal from the second audio signal to at least partially cancel the distorted echo of the first audio signal from the second audio signal.

23. The method of claim 22, wherein the modeling step comprises the step of: adaptively modeling one or more types of distortion.

24. The method of claim 22, wherein the modeling step comprises the step of: modeling a pre-established type of distortion.

25. The method of claim 22, further comprising the step of:
retrieving sequencing information from the first and second audio signals;
wherein the subtracting step uses the sequencing information to at least partially cancel the distorted echo of the first audio signal from the second audio signal.

26. The method of claim 22, wherein the modeling step comprises the step of: passing the first audio signal through a modeling path comprising one or more distortion modules, each distortion module applying a type of distortion to the first audio signal.

27. The method of claim 26, wherein the modeling path models distortions that occur responsive to playing the first audio signal through a loudspeaker.

28. The method of claim 27, wherein the passing step comprises the step of: passing the first audio signal through a distortion module that models an effect of amplifier clipping on the first audio signal.

29. The method of claim 27, wherein the passing step comprises the step of:
passing the first audio signal through a distortion module that models an effect of voice coil displacement on sound pressure waves produced by the loudspeaker responsive to the first audio signal.

30. The method of claim 27, wherein the passing step comprises the step of:
passing the first audio signal through a distortion module that models an effect of harmonic distortion on the sound pressure waves produced by the loudspeaker responsive to the first audio signal.

31. The method of claim 27, wherein the passing step comprises the step of:
passing the first audio signal through a distortion module that models an effect of hysterisis in inductors containing iron on the first audio signal.

32. The method of claim 26, wherein the modeling path models distortions that occur responsive to sensing the second audio signal.

33. The method of claim 32, wherein the passing step comprises the step of:
passing the first audio signal through a distortion module that models an effect of microphone centerclipping on the second audio signal.

34. The module of claim 32, wherein the passing step comprises the step of:
passing the first audio signal through a distortion module that models an effect of amplifier zero crossing distortion on the second audio signal.

35. A terminal for an audio communications system, the terminal comprising:
a loudspeaker for producing sound pressure waves responsive to a received first signal;

a microphone for converting sound pressure waves into a second signal, wherein a portion of the second signal represents an echo of the sound pressure waves produced by the loudspeaker;

a distortion module receiving the first signal and adapted to modify the first signal to model a type of distortion to produce a distorted signal; and

an adder module for removing at least a portion of the echo of the sound pressure waves produced by the loudspeaker from the second signal responsive to the distorted signal.

36. The terminal of claim 35, wherein the first and second signals bear sequencing information and wherein the echo cancellation module is adapted to use the sequencing information to remove at least part of the echo from the second signal.

37. The terminal of claim 35, further comprising:

an audio generation module receiving the first signal and adapted to use the distortion module to model a distortion that occurs responsive to playing the first signal through the loudspeaker.

38. The terminal of claim 37, wherein the audio generation module has a modeling path comprising one or more distortion modules that model distortions on the first signal.

39. The terminal of claim 38, wherein each of the one or more distortion modules models a different type of distortion.

40. The terminal of claim 38, wherein the audio generation module alters the modeling path in real-time responsive to distortions that may occur on the first signal.

41. The terminal of claim 37, wherein the distortion module models an effect of amplifier clipping on the first signal.

42. The terminal of claim 37, wherein the distortion module models an effect of voice coil displacement on the sound pressure waves produced by the loudspeaker.

43. The terminal of claim 37, wherein the distortion module models an effect of hysterisis in an iron core inductor on the first signal.

44. The terminal of claim 37, wherein the distortion module models an effect of harmonic distortion introduced by the loudspeaker on the sound pressure waves.

45. The terminal of claim 35, further comprising:

an acoustic echo estimation module receiving the first signal and for adapting the first signal to compensate for substantially linear changes in the second signal.

46. The terminal of claim 35, further comprising:

an audio sensing module receiving the first signal and adapted to use the distortion module to model a distortion that occurs responsive to sensing the audio signal.

47. The terminal of claim 46, wherein the audio sensing module has a modeling path comprising one or more distortion modules that model distortions on the second signal.

48. The terminal of claim 47, wherein each of the one or more distortion modules models a different type of distortion.

49. The terminal of claim 47, wherein the audio sensing module alters the modeling path in real-time responsive to distortions that may occur on the second audio signal.

50. The terminal of claim 46, wherein the distortion module models an effect of microphone centerclipping on the second signal.

51. The terminal of claim 46, wherein the distortion module models an effect of amplifier zero crossing distortion on the second signal.